Ecological Integrity Subcommittee (EIS)
New England Aquarium Administrative Offices

Boston, MA
9:00 am to 12:00 pm
22 July 2005

MEETING SUMMARY

Subcommittee Attendees (July 22, 2005):

Name	**WG Seat / Affiliation**	**Attendance**
Les Kaufman	Boston University	Present
Deb Cramer	Science Writer	Present
Charles Casella	Recreational Fishing	Present
David Bergeron	MA Fishermen's Partnership	Present
David Pierce	Government / MA Div. of Marine Fisheries	Present
Mike Fogarty	NMFS	Present
Others Present		
Timothy Feehan	PSGS	Present
Elizabeth Soule	Boston University	Present
Lydia Bergen	New England Aquarium	Present

WELCOME AND CHARGE FOR THE DAY

Les Kaufman, EIS Chair, thanked those in attendance for their participation and opened the meeting. After brief introductions for all participants, Les reviewed the charge of the EIS. The Zoning (Z) Working Group (WG) set up the EIS to make the WG more efficient by providing a definition for ecological integrity (EI). The goal is to develop a definition that is broad and comprehensive but also has an operational component with quantifiable parameters enabling periodic assessments of the status of the sanctuary's integrity. Prior to the meeting, Les Kaufman had asked each subcommittee member to come prepared with (see Appendix A):

1. Top 10 parameter to measure as components of an index of ecological integrity for Stellwagen Bank National Marine Sanctuary.
2. A specific vision of what the biological communities on Stellwagen Bank would look like.
3. A means of determining what the actual, measurable values of the top 10 parameters would be.

David Pierce reminded the subcommittee that the Ecosystem Based Management (EBM) WG originally called for the creation of a group to define ecological integrity:

> *"EBM.4 Objective—To Understand Ecosystem Structure and Function*
>
> ***Background***
> Ecosystem structure refers to how the components of an ecosystem are arranged, both horizontally and vertically. Ecosystem function refers to the processes that structure the ecosystem such as predation, succession, reproduction, and competition. The purpose of

this strategy is to understand what components make up the sanctuary ecosystem and what processes influence the arrangement of the components.

Strategies To Understand Ecosystem Structure and Function(14)

(4.1) *Develop an operational definition of ecological integrity.*
Ecological integrity is a term that is location and scale dependent. It is both an intuitive and a technical term. While ecological integrity has not yet been defined for the SBNMS various definitions point to the notion of maintaining the wholeness of an ecosystem, or portion thereof, such that the system's native diversity and functioning are likely to persist. The objective of this activity is to develop an operational definition of ecological integrity that can be evaluated and monitored over time.

Status: Draft operational definition and metrics for measuring ecological integrity by year 1.

Potential Partners: Proposed research steering committee, proposed consortium, fishermen, other users."

It was commented that this subcommittee was only the first step in the process and that the recommendations of the subcommittee would be reviewed at a later time. The definition for ecological integrity may change over time, but the recommendations of the subcommittee would provide a useful foundation to work from.

DEFINING EI
The Chair opened the table for discussion on ecological integrity. To keep the flow of discussion on topic, discussions were focused on the 3 topics that each subgroup member was asked to prepare, as listed above.

EI Biological Parameters
Many biological parameters were identified by subgroup members. Many of these parameters were overlapping. The parameters identified by members can be found in Appendix B.

Discussion: The parameters as presented by each member in Appendix B were discussed. Mainly, each member agreed that parameters for EI should include items such as abundant higher trophic level species, clean water, abundant plankton with proper species diversity, complete age structure of and abundance traditional fish species, abundant and diverse populations of forage species and abundant benthic flora and fauna. It was pointed out that in the Ocean Conservancy's latest issue of Blue Planet, there is a photo of habitat that is very diverse. It was agreed that this type of diversity is what the SBNSM should contain. It is important to identify where these habitats are so that measures can be taken to protect them. Also, more pictures like this one should be made available. Fishermen and other users of the sanctuary would gain a better understanding of the need for diversity and would be more apt to identify ways of protecting such habitat. Areas such as the one in the photo need to be identified to determine how widespread these areas are. It was also pointed out that similar photos should be released that show other habitats such as mud, sand, gravel and cobble.

EI Vision
Each subgroup member provided a specific vision of what the biological communities on Stellwagen Bank would look like if the measurements for all parameters were indicative of a healthy sanctuary. Individual visions from each subgroup member can be found in Appendix B.

Discussion: A major point brought up by a few members was that human involvement in the ecosystem was important and should be considered part of the ecosystem and also be part of the definition of EI. Members were in agreement that the vision of the sanctuary is one of abundant and divers species of all sizes, and a healthy, well ordered food web. The vision should be a mix of ecological structure and function, including a role for humans in the ecosystem.

It was also stated that the SBNMS is embedded in the Gulf of Maine (GoM). Because of this, the sanctuary must have strategy for dealing with effects from outside the boundary of the sanctuary. EI is an important concept, linked to ecosystem-based management. Many factors outside the sanctuary will affect the GoM ecosystem, including the sanctuary. This complex issue can make determining metrics a difficult problem.

EI Measurable Values for Biological Parameters
The measurable values for biological parameters, as presented by each subgroup member can be found in Appendix B.

Measurable parameters
Discussion: It was agreed by members that there was a need for both qualitative and quantitative measures. Some of the members stated that there was a need to involve other user groups and specialists to develop measures. The photo in Blue Planet is a qualitative measure for the sanctuary. Such photos can make a strong argument for investigating certain habitat types. Qualitative items such as the photo make a clearer connection with the public at large, and the process should not get bogged down in discussion on developing quantitative measures.

It was pointed out by members that there is a clear need to understand the flow of energy through system. A better understanding of trophic relationships is important, but there needs to be the realization that the ecosystem, as a whole, functions differently than each of its component parts (or trophic level). The structure of each trophic level could change (i.e. population densities of herring versus sand lance or mackerel), yet the ecosystem as a whole could still be functionally similar. Different scales can really show how the ecosystem is functioning.

It was also suggested by some members to use historic estimates of what the ecosystem was like prior to European involvement. Such data would make a useful historic baseline. Other members were uncomfortable with such historic data and questioned why more contemporary data that involved a history of human uses could not be used. It was argued that there needs to be an understanding that things have changed globally and not just look at what the sanctuary would look like without human uses when the entire global environment has been altered by human use. It was explained that it was not the intention to exclude human use, just that there was a need to establish an historic baseline. As for global change, there is currently an observing system on Georges Bank to monitor global conditions and climate. At this point in time, this project is in the process of synthesizing data with oceanography. Data has indicated dramatic changes related to climate change, like the North Atlantic Oscillation. There has also been observed diet changes in species that can be associated with climate change data. Sand lance was high in abundance in gut content of predators, while herring was low in the 1970's. At present, there is the opposite, with herring being high and sand lance low in gut content levels of predators. Predator

species show a switching behavior to target the most prevalent forage. Forage may be interchangeable, but there could be different energetic consequences for the predator based on the forage it pursues.

There was agreement that it is important to have an idea of what the ecosystem looked like, i.e. historic cod stocks. High cod abundance with proper age structure is most likely a useful indicator of high EI. Having a huge population of nothing but spiny dogfish would be an indicator that there is an issue with EI. An overabundance of one species is an indication that something in the system is out of whack. There is a need to get a better handle on the dogfish issue. Members pointed out that current data shows a decline in females in the GoM, which has shut down the fishery. However, the population may segregate by sex. There seems to be a high abundance of female spiny dogfish off RI, NY and the backside of Cape Cod.

Sea herring abundance is also an important measure for EI. High abundance levels, both inside and around the sanctuary, is needed; however that creates issues, as herring migrate in and out of the sanctuary. The sanctuary does not manage fisheries, but there needs to be management of the local depletion of sea herring. Another forage species, sand lance, is important as well. Greater understanding of sand lance is needed to establish a link to this species and have more understanding of predator/prey relationships.

It was also suggested by some members that there was a need to identify measures of shore-based activity that could impact the sanctuary. Water quality is impacted by such activity. Plankton species like *Calanus finmarchicus* could be an important indicator of a change in EI. There was agreement that attention has always been given to extractive uses such a fishing, but the issue of land-based impacts has not been addressed.

There is a need for guilds or groups of species to observe life history aspects. It was recommended by the subgroup that the sanctuary needs the capacity and infrastructure to carry out such observations. The group can identify targets, but need the ability to monitor the environment.

Experiments within the SBNMS
Discussion:
For monitoring EI within the sanctuary experiments that provide information on the local scale of the sanctuary, not just the whole GoM, must be conducted. There is currently data on fish species abundance in closed areas. NOAA is looking at possible 'spill-over' effects where abundance increases on the outside edges of a closed area. It has been observed that there is a buildup of biomass and some spillover effects with species such as haddock and flounder in areas such as Closed Area II (CAII). However, the Western GoM (WGoM) closure is a bit different, but still a very important area. CAII and the WGoM closures have provided good studies. There is a need to standardize this type of activity to monitor effects of management, especially in closed areas.

Research and monitoring needs to be highlighted within the sanctuary; however this can cause issues as this topic overlaps with fishery management. There is still a need to apply what we already know. There is a need for large fish (quantity and quality of egg production, full age structure) but currently no measure targeting the conservation of large fish. It was pointed out that the state of MA is starting to implement measures to protect spawning and pre-spawn cod. The state is looking for information now from stakeholders. There is a move to the fishery management council to protect large cod as well. Very large cod were caught in December during research. State biologists are not sure what was going on, but think it was related to migration or spawning patterns. However, the state wants to avoid unnecessarily impacting fishermen until they have real data as well as an idea of how their management action may

positively impact the whole region. It was suggested by some members that with any recommended definition of EI, it must be clear that the subgroup is not solving policy, and the group is only charged with defining EI.

There was some question on how to satisfy a segment of the public that would like to see a part of the GoM with zero extraction. Members suggested that education of the entire public could lead to a time when such an idea could be acceptable, but the subgroup currently needs to stay away from ideas like "wilderness" or "preserve". Some members stated that 'no take' zones have quantitative value for experiment. Much has been learned much from the groundfish closures and 'no take' areas are valuable for monitoring EI. There is a need to have a measure which will tell us when we actually have EI and need to have a long-term commitment. It is possible to zone some areas, and not close the whole sanctuary. Research areas need to be stratified random, which means it doesn't matter where they are, as long as they have the habitat needed. Habitat areas of particular concern (HAPC) could be used as well. Those areas may have habitat comparable with that found within the sanctuary. Other members stressed that it is important to state that closures have had the effect of redistributing commercial fishing effort. Such redistribution must be considered, even when determining areas closed for research. Fishermen may be pushed from parts of the sanctuary. Defining EI could also have that effect. It was cautioned by these members that the subgroup needed to be careful, as pushing fishermen out of fishing grounds can cause conflict and increase safety risks which could lead towards a feeling of resentment of the sanctuary.

Measurable parameters for human populations and uses

Discussion: Considering human populations and uses, there was a clear need to balance people with restoring the ecosystem. Such action could possibly be done incrementally. Some members stated that all involved in the process needed to continue to look at things collectively. There must be a continuing collaborative effort until a system is developed to properly monitor the sanctuary ecosystem.

Measures of the human community need to be developed that will indicate if the community is in line with EI. The community within the GoM watershed will have impact on water quality. This may be hard to quantify, but there is a need for info on the social science side of things. The sanctuary will need the capacity to observe the social science issues that can impact the sanctuary. It was suggested by some members that possible measures could include monitoring utilization rates of fish landed from within the sanctuary both commercially and recreationally. It was suggested that some members of the recreational fishing community could support more detailed reporting of catch, but they would not want to see the sanctuary become an 'aquarium' that they could only see from afar and not go in to fish. A marketing database with surveys of effort could also be helpful in determining EI as it relates to human users.

NEXT STEPS

Notes of the meeting will be synthesized and distributed to subgroup members. A report can then be developed to deliver to the Z WG. The possibility still exists for another meeting of the subgroup after the notes are synthesized.

FINAL COMMENTS

Meeting adjourned.

APPENDIX A

Ecological Integrity Subgroup Assignment

Please bring to the meeting (or if you can not make the meeting but want to have input, email these to me for distribution at the meeting) three things:

1. Your choice of ten biological parameters to measure as components of an index of ecological integrity for Stellwagen Bank National Marine Sanctuary. People are animals and things about them that you might choose to measure are biological parameters, too.

2. A specific vision of what the biological communities on Stellwagen Bank would look like if the measurements for all of your top ten parameters were indicative of a beaming, shiny healthy Sanctuary. Once again, remember that for the purposes of this exercise, people are marine mammals; we want them to be happy and sustainable, too. Please think explicitly in terms of the various habitats: sand, gravel, boulder reefs, mud, ocean midwater and surface.

3. A means of determining what the actual, measurable values of your top ten parameters would be under current oceanographic and climatological conditions, but in the complete absence of all local human environmental impacts to the Stellwagen Bank region (i.e., this isn't the place where we're going to stop global warming, but we can imagine an imaginary no-fishing, no-pollution, no-lousy boatsmanship scenario). In other words, what is the current potential for the system? For example, we might use historical reconstruction (captain's logs of abundance, etc.), ecological models, or closed-area experiments. Or some other approach if you can think of one.

APPENDIX B

Ecological Integrity
Subgroup Member Submittals

Defining Ecological Integrity
David Pierce

Ecological integrity refers to a highly desirable status of an ecosystem - a status affected by oceanographic processes and human impacts and assessed in quantitative and qualitative ways. Those processes and impacts pertain to effects on ecosystem structure and function necessary for promoting high biological productivity of biological communities, abundance and diversity of marine life within those communities, and wise use of those resources. High ecological integrity refers to minimized human impact and the existence of environmental conditions all favoring high productivity, widespread biodiversity and abundant pelagic and demersal marine resources for recreational and commercial fisheries, public enjoyment, and predator-prey dynamics promoting that productivity, biodiversity, and enjoyment. Assessment of ecological integrity must be primarily qualitative and instinctive until ecosystem-based management evolves to the point where quantitative assessments of ecosystem status are feasible, i.e., until a suite of ecosystem multiple metrics can be developed and applied. Those metrics must be sensitive to change, directional, general enough to be useful, feasible to measure, and able to incorporate uncertainty.

Defining Ecological Integrity
David Bergeron

Implementation of social parameters of ecological integrity is transferable to management. If the social parameters are maintained at adequate performance levels, then management becomes easier, reducing costs.

Ecological Integrity, a proposed definition:

Ecological integrity is the balanced functioning of dynamic relationships between social/cultural and biophysical systems [that successfully integrates human cultural diversity in research/education, industry and management] to maintain the ability of the ecosystem to continue biological productivity across a representative range of trophic levels, which are characteristic (naturally occurring) to the region.

Quantifiable measures of parameters of human dimensions:
(Measured by geographic census of the presence or absence of the activities)

- People collaboratively studying & observing nature and people
- People earning a living by fishing commercially & collaborating with education or research
- People fishing recreationally & collaborating with education or research
- Social scientists working on interdisciplinary research with natural scientists
- People on shore discovering how people on the water interact & relate with one another and the marine ecology

Other measures (courtesy Troy Heartley)

Capacity among resource users (both individually and their organizations/institutions) to monitor the health of ecosystems:

- Capacity = staff, financial resources, experience, etc.
- Resource users = commercial fishermen, recreational fishermen, party boats, tour boats/whale watchers, recreational boaters, etc…
- Monitoring health of ecosystem = research, monitoring, active/sustained

Awareness levels among various "communities" within the ecosystem boundaries about the ecosystem and its health. Communities run the continuum from resource user groups with direct contact with the system to the broader public at large.

Behaviors consistent with maintaining ecological integrity, within the various communities.

Economic viability

- employment figures
- livable wage
- economic value of ecosystem resources

Equity issues among people interacting with the ecosystem

- distribution of wealth
- access to health care
- working waterfront

Defining Ecological Integrity
Mike Fogarty (Summary from discussion)

Ecological integrity is very much a vision statement unto itself that has:

1. Ecological structure and function
2. Role of humans in the ecosystem

What is needed is to merge the two ideas. Going from there to something more specific is the real task.

Key Issue
The SBNMS is embedded in the Gulf of Maine (GoM). Each question that is developed must have a strategy for dealing with the sanctuary as a subset of the GoM and the affects from outside the sanctuary itself.

Measurable Values
Measuring the parameters for ecosystem integrity could be done by understanding how energy flows through the ecosystem, from one trophic level to the next. We also need an understanding of the biomass at each trophic level. It is necessary to think about how much the system can support. For a pristine system, as an example, focus could be directed on upper trophic levels (mammals, tuna, birds, turtles).

A second concept to understand is how the ecosystem functions. A complete ecosystem as a whole functions differently than each of its parts. The structure of each trophic level could change (i.e. population densities of herring versus sand lance or mackerel), yet the ecosystem at a whole could still functionally be similar. Different scales can really show how the ecosystem is functioning.

One way to do this is to compare the ecosystem at present with a projected historic ecosystem prior to European influence. This can provide a historic baseline. This could be used, in conjunction with a contemporary information base to seek a balance between historic levels and present human uses.

Defining Ecological Integrity
Chuck Casella (Summary from discussion)

The ecological integrity of the SBNMS should show abundant higher trophic levels such as marine mammals and tuna. The abundance of such higher order species would be indicative of abundant lower trophic level species. In addition to high abundance of all species in the food web, water quality must be high. Also included in ecological integrity is human uses such as whale watching and fishing. For fish species, a complete range in traditional species and year classes need to be found within the sanctuary.

Top 10 Parameters:

1. Water quality
2. Cobble and boulder habitat
3. Benthic vegetation
4. Crustaceans
5. Sand lance and worms
6. Mollusks
7. Marine mammals, tuna, turtles and birds
8. Traditional fish species and full range of year classes
9. Abundant forage species
10. Abundant primary and secondary producers (phytoplankton and zooplankton)

Defining Ecological Integrity
Deb Cramer (Summary from discussion)

For ecological integrity, studies should be conducted on historic population levels and carrying capacity. For fish stocks, the historic age at maturity should be investigated, then strive to return to that population structure as best as possible. The food web should be full and complete with many large predators and abundant plankton. Many times, the focus is put on extraction and its effects; however, there is a significant need identify a measurable marker from shore-side activity and its effects. There is a study done in the North Sea looking at warm water versus cold water species of copepods and how the populations are shifting. Warm water species populations are on the rise causing changes in predator/prey relationships that could be affecting cod populations. For Stellwagen Bank the copepod, *Calanus finmarchicus*, could be a used as an indicator species. The SBNMS needs the capacity to carry out the monitoring of such species.